REVIEW ABSTRACT

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Title: SCALING NOMINAL SOLAR CELL IMPEDANCES FOR ARRAY DESIGN

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Objective: Characterize solar cell array AC impedance and develop scaling rules for impedance characterization of large arrays by testing single solar cells and small arrays.

Scope: Present the AC impedance characteristics of several types of solar cells and small solar cell arrays under different load points and intensities. Formulate a methodology for estimating the AC impedance of the Mars Pathfinder (MPF) cruise and lander solar arrays based upon testing single cells and small solar cell arrays. Create a basis for design of a single shunt limiter for MPF power control of flight solar arrays having very different impedances.

Introduction: The MPF mission uses solar arrays as a direct energy conversion system for battery charging and as a primary power source. Due to mass and cost constraints, the same shunt limiter electronics will be used for power regulation on both the cruise and lander stages of the mission. Relatively large spacecraft power requirements near the end of cruise just prior to Mars entry, and limitations on lander mass further restricted the power subsystem design. Other mission constraints include the use of fixed solar arrays with one week of direct sun pointing near Earth and a 40.6 degree off-sun attitude at Mars. The above constraints resulted in use of a gallium arsenide (GaAs) cell solar array for the cruise stage and a silicon back surface field/reflector (Si BSFR) cell solar array for the lander. Previous work had shown that the AC impedance of silicon BSF cells was very different from that of non-BSF cells. There was immediate concern about how the difference in AC impedance would influence the design and stability of a single shunt limiter circuit. A methodology for estimating the AC impedance of solar arrays in general, and more specifically the MPF cruise and lander arrays, is the main focus of this paper.